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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/544,270	08/03/2005	Arthur H. Hartog	101.0098	1326

50258 7590 01/22/2008
SCHLUMBERGER TECHNOLOGY CORPORATION
14910 AIRLINE ROAD
ROSHARON, TX 77583

EXAMINER	
LAPAGE, MICHAEL P	

ART UNIT	PAPER NUMBER
4158	

MAIL DATE	DELIVERY MODE
01/22/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/544,270	HARTOG, ARTHUR H.	
	Examiner	Art Unit	
	MICHAEL LAPAGE	4158	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 August 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *See Continuation Sheet* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *See Continuation Sheet* is/are rejected.

7)☒ Claim(s) *1,2,4,5,11,12,15,16,19-21,26,39,42,43,49,50,53,54,57-59,64,69-71 and 77* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03 August 2005* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

Continuation of Disposition of Claims: Claims pending in the application are 1,2,4-6,10-12,14-16,19-22,26,28-30,35,36,39,40,42-44,48-50,52-54,57-60,64,66-74 and 77.

Continuation of Disposition of Claims: Claims rejected are 1,2,4-6,10-12,14-16,19-22,26,28-30,35,36,39,40,42-44,48-50,52-54,57-60,64,66-74 and 77.

DETAILED ACTION

1. Claims 1-77 are presented for examination.

2. Claims 1-2, 4-6, 10-12, 14-16, 19-22, 26, 28-30, 35-36, 39-40, 42-44, 48-50, 52-54, 57-60, 64, 66-74, and 77 are pending before the United States Patent Office.

3. Claims 3, 7-9, 13, 17-18, 23-25, 27, 31-34, 37-38, 41, 45-47, 51, 55-56, 61-63, 65, 75-76 are made of record as being canceled by applicant in preliminary amendment.

Specification

4. The following guidelines illustrate the preferred layout for the specification of a utility application. These guidelines are suggested for the applicant's use.

Arrangement of the Specification

As provided in 37 CFR 1.77(b), the specification of a utility application should include the following sections in order. Each of the lettered items should appear in upper case, without underlining or bold type, as a section heading. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

(a) TITLE OF THE INVENTION.
(b) CROSS-REFERENCE TO RELATED APPLICATIONS.
(f) BACKGROUND OF THE INVENTION.
    (1) Field of the Invention.
    (2) Description of Related Art including information disclosed under 37 CFR 1.97 and 1.98.
(g) BRIEF SUMMARY OF THE INVENTION.
(h) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S).
(i) DETAILED DESCRIPTION OF THE INVENTION.

(j) CLAIM OR CLAIMS (commencing on a separate sheet).
(k) ABSTRACT OF THE DISCLOSURE (commencing on a separate sheet).

5. The abstract of the disclosure does not commence on a separate sheet in accordance with 37 CFR 1.52(b)(4). A new abstract of the disclosure is required and must be presented on a separate sheet, apart from any other text.

6. The disclosure is objected to because of the following informalities:
Throughout the specification the term "fibre" should be replaced with --fiber--;
Throughout the specification the term "polarisation" should be replaced with --polarization--;
Throughout the specification the term "localised" should be replaced with --localized--.

7. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Appropriate correction is required.

Drawings

8. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: 35, it appears as though on page 27, line 5 that “34, 37” should read

–34, 35--. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

9. Claims 64, 66-68 are objected to because of the following informalities: After preliminary amendments claim 64 is dependent on a canceled claim and therefore claims being dependent on 64 are also objected to. Appropriate correction is required.

10. Claims 1-2, 4-5, 11-12, 15-16, 26, 39, 42-43, 49-50, 53-54, 64, 69-71, and 77 are objected to because of the following informalities: In all of the claims noted above the word "fibre" should read --fiber--.

11. Claims 4, and 42 are objected to because of the following informalities: In all of the claims noted above the word "polarised" should read --polarized—

12. Claims 19-21, 57-59 are objected to because of the following informalities: In all of the claims noted above the word "localised" should read --localized— Appropriate correction is required.

Claim Rejections - 35 USC § 102

13. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

14. Claims 1 and 39 are rejected under 35 U.S.C. 102(b) as being anticipated by Kersey (U.S. Patent No. 5,757,487 and Kersey hereinafter).

As to claim 1, Kersey discloses a method of measuring at least one selected parameter at a location within a region of interest, which method comprises the steps of: launching optical pulses at a plurality of preselected interrogation wavelengths into an optical fibre deployed along the region of interest, reflectors being arrayed along the optical fibre to form an array of sensor elements, the optical path length between the said reflectors being dependent upon the selected parameter (col. 2, lines 50-63; col. 3, lines 16-23; Fig. 1);

detecting the returned optical interference signal for each of the preselected wavelengths (col. 3, lines 3-30); and

determining from the optical interference signal the absolute optical path length between two reflectors at the said location, and from the optical path length so determined the value of the selected parameter at the said location (col. 3, lines 39-46; col. 3, lines 56-60).

As to claim 39, Kersey discloses a apparatus for measuring a selected physical parameter at a location within a region of interest, which apparatus comprises: an optical fibre for deployment along the region of interest, the optical fibre having reflectors therealong forming an array of sensor elements, the optical path length between the said reflectors being dependent upon the selected parameter (col. 2, lines 50-63; col. 3, lines 16-23; Fig. 1);

source means operable to launch optical pulses at a plurality of preselected interrogation wavelengths into the said fibre (col. 1, lines 25-28);

signal detection means operable to detect the returned optical interference signal for each of the preselected wavelengths (col. 3, lines 23-30); and

signal processing means operable to determine from the optical interference signal the absolute optical path length between two reflectors at the said location and to determine from the optical path length so determined the value of the selected parameter at the said location (col. 3, lines 39-46; col. 3, lines 56-60).

Claim Rejections - 35 USC § 103

15. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

16. Claims 2 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kersey in view of Hill (U.S. PGPub No. 2005/0151950 A1 and Hill hereinafter).

Although the system discloses in Kersey shows substantial features of the claimed invention (discussed in paragraphs above), it fails to disclose:

A method where the step of determining the absolute optical path length comprises carrying out a process in which the derivative of the phase as a function of wavelength is estimated from a subset of the interference signals, using the derivative and an estimated value for the optical path length to estimate the phase relationship between the interference signals, and the phase relationship thus obtained is used to revise the estimated value for the optical path length, the process being repeated for increasing subsets of the remaining wavelengths in sequence, on the basis of the optical path length estimated for the immediately preceding subset in the sequence, thereby to progressively revise the optical path length until it is known to a desired level of accuracy [claim 2].

An apparatus where the said signal processing means is operable to determine the absolute optical path length by carrying out a process in which the derivative of the phase as a function of wavelength is estimated from a subset of the interference signals, using the derivative and an estimated value for the optical

path length to estimate the phase relationship between the interference signals, and the phase relationship thus obtained is used to revise the estimated value for the optical path length, the process being repeated for increasing subsets of the remaining wavelengths in sequence, on the basis of the optical path length estimated for the immediately preceding subset in the sequence, thereby to progressively revise the optical path length until it is known to a desired level of accuracy [claim 40].

Nonetheless, these features are well known in the art and would have been obvious modifications of the method and apparatus disclosed in Kersey, as evidenced by Hill.

A method where the step of determining the absolute optical path length comprises carrying out a process in which the derivative of the phase as a function of wavelength is estimated from a subset of the interference signals, using the derivative and an estimated value for the optical path length to estimate the phase relationship between the interference signals, and the phase relationship thus obtained is used to revise the estimated value for the optical path length, the process being repeated for increasing subsets of the remaining wavelengths in sequence, on the basis of the optical path length estimated for the immediately preceding subset in the sequence, thereby to progressively revise the optical path length until it is known to a desired level of accuracy [claim 2] ([0081], lines 47-50; [0083], lines 15-20) where phase relationships are commonly used to analyze interferometric size measurements, and further

repeating the process is commonly known in mathematics to further refine out error from any type of measurements

An apparatus where the said signal processing means is operable to determine the absolute optical path length by carrying out a process in which the derivative of the phase as a function of wavelength is estimated from a subset of the interference signals, using the derivative and an estimated value for the optical path length to estimate the phase relationship between the interference signals, and the phase relationship thus obtained is used to revise the estimated value for the optical path length, the process being repeated for increasing subsets of the remaining wavelengths in sequence, on the basis of the optical path length estimated for the immediately preceding subset in the sequence, thereby to progressively revise the optical path length until it is known to a desired level of accuracy [claim 40] ([0081], lines 47-50; [0083], lines 15-20) where phase relationships are commonly used to analyze interferometric size measurements, and further repeating the process is commonly known in mathematics to further refine out error from any type of measurements.

Given the teaching of Hill, a person having ordinary skill in the art at the time of the invention would have readily recognized the desirability and advantages of modifying Kersey by employing the well-known features of interferometric setups and optical path length to find the correct phase of light traveling down a waveguide. Further it is widely known in the art to gain accuracy in an experiment multiple measurements can be used to remove any outliers, and also allow an average which leads to an overall more accurate measurement.

17. Claims 35, 73, and 77 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kersey in view of Waagaard (U.S. Patent No. 7,019,837 B2 and Waagaard hereinafter).

Although the system discloses in Kersey shows substantial features of the claimed invention (discussed in paragraphs above), it fails to disclose:

A method where the returned optical interference signal is processed to remove the cross-talk term, the cross-talk term being removed for each of n sensor elements (i.e. defined in disclosure as reflectors along fiber) by subtracting the cross-talk phasor for the nth sensor element from the measured nth sensor element phasor, the removal process beginning with subtraction of the cross-talk phasor for the second sensor element from the measured second sensor element phasor, the cross-talk phasor for the first sensor element in the array being zero [claim 35].

An apparatus where the signal processing means is further operable to process the returned optical interference signal to remove the cross-talk term, the cross-talk term being removed for each of the n sensor elements by subtracting the cross-talk phasor for the nth sensor element from the measured nth sensor element phasor, the removal process beginning with subtraction of the cross-talk phasor for the second sensor element from the measured second sensor element phasor, the cross-talk phasor for the first sensor element in the array being zero [claim 73].

A method of measuring a parameter in an optical fibre interferometric array, comprising launching optical pulses into the array, creating an interference signal

within sensor elements in the array, detecting the phase of the interference signals, where the returned optical interference signal is processed to remove the cross-talk term, the cross-talk term being removed for each of n sensor elements by subtracting the cross-talk phasor for the nth sensor element from the measured nth sensor element phasor, the removal process beginning with subtraction of the cross-talk phasor for the second sensor element from the measured second sensor element phasor, the cross-talk phasor for the first sensor element in the array being zero [claim 77]

Nonetheless, these features are well known in the art and would have been obvious modifications of the method and apparatus disclosed in Kersey, as evidenced by Waagaard.

A method where the returned optical interference signal is processed to remove the cross-talk term, the cross-talk term being removed for each of n sensor elements (i.e. defined in disclosure as reflectors along fiber) by subtracting the cross-talk phasor for the nth sensor element from the measured nth sensor element phasor, the removal process beginning with subtraction of the cross-talk phasor for the second sensor element from the measured second sensor element phasor, the cross-talk phasor for the first sensor element in the array being zero [claim 35] (col. 1, lines 58-67; col. 2, lines 1-5; col. 4, lines 38-43, 63-65; col. 5, lines 1-12) where removing cross-talk phasors is used to allow proper analysis of desired signals.

An apparatus where the signal processing means is further operable to process the returned optical interference signal to remove the cross-talk term, the cross-

talk term being removed for each of the n sensor elements by subtracting the cross-talk phasor for the nth sensor element from the measured nth sensor element phasor, the removal process beginning with subtraction of the cross-talk phasor for the second sensor element from the measured second sensor element phasor, the cross-talk phasor for the first sensor element in the array being zero [claim 73] (col. 1, lines 58-67; col. 2, lines 1-5; col. 4, lines 38-43, 63-65; col. 5, lines 1-12) where removing cross-talk phasors is used to allow proper analysis of desired signals.

A method of measuring a parameter in an optical fibre interferometric array, comprising launching optical pulses into the array, creating an interference signal within sensor elements in the array, detecting the phase of the interference signals, where the returned optical interference signal is processed to remove the cross-talk term, the cross-talk term being removed for each of n sensor elements by subtracting the cross-talk phasor for the nth sensor element from the measured nth sensor element phasor, the removal process beginning with subtraction of the cross-talk phasor for the second sensor element from the measured second sensor element phasor, the cross-talk phasor for the first sensor element in the array being zero [claim 77] (col. 1, lines 58-67; col. 2, lines 1-5; col. 4, lines 38-43, 63-65; col. 5, lines 1-12) where removing cross-talk phasors is used to allow proper analysis of desired signals.

Given the teaching of Waagaard, a person having ordinary skill in the art at the time of the invention would have readily recognized the desirability and advantages of modifying Kersey by employing the well-known features of

interferometric setups. It is widely known in the art that cross-talk can become an issue when using multiple signals along one fiber. Therefore it would have been obvious to subtract cross-talk to allow for proper measurement of the signal in question.

18. Claims 5-6, 10-12, 14-16, 19-21, 26, 28-30, 36, 43-44, 48-50, 52-54, 57-59, 60, 64, 66-69, 72, and 74 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kersey in view of Prohaska et al (U.S. Patent No. 6,208,776 B1 and Prohaska hereinafter).

Although the system discloses in Kersey shows substantial features of the claimed invention (discussed in paragraphs above), it fails to disclose:

A method where the optical fibre comprises polarisation-maintaining fibre and light is launched into the fibre in such a way that the power of the light signal is firstly directed entirely into one of the principal states of polarisation and then the other, thereby to interrogate the principal states of polarisation sequentially, the returned interference signals from both principal states of polarisation being used separately in the said process for determining the absolute optical path length for each propagation mode independent of the other mode [claim 5].

A method in which the selected parameter comprises temperature [claim 6].

A method in which the selected parameter comprises strain [claim 10].

A method where the optical fibre is a high-birefringence fibre, the birefringence of which changes in response to strain applied to the optical fibre [claim 11].

A method where the birefringence of the high-birefringence fibre also changes in response to temperature, and the method further comprises compensating the

returned optical interference signal for effects arising from temperature at the said location [claim 12].

A method in which the selected parameter comprises pressure [claim 14].

A method where the said optical fibre comprises a side-hole fibre [claim 15].

A method where each sensor element of the fibre is located within a sealed elliptical tube filled with a pressure-transmitting fluid [claim 16].

A method where the selected parameter depends on a localised event moving along the region of interest, and the method comprises determining the value of the selected parameter over time at more than one said location, and determining the movement of the localised event from the determined values of the selected parameter [claim 19].

A method where the localised event is a user-induced event, and the method further comprises inducing the localised event [claim 20].

A method as where the localised event is a volume of fluid within the region of interest that has a different temperature, pressure, or density from surrounding fluid in the region of interest, the selected parameter being temperature, pressure, or density, respectively [claim 21].

A method where the measured value for the parameter is used to determine the value for a further measurand dependent upon the said parameter and where the said optical fibre is provided with a coating which responds to the said further measurand by stretching or shrinking [claim 26].

A method where the said coating is electro-strictive [claim 28].

A method where the said coating is magneto-strictive [claim 29].

A method where the said coating is sensitive to a selected chemical measurand [claim 30].

A method where the region of interest lies within an oil well [claim 36].

An apparatus where the said optical fibre comprises polarisation-maintaining fibre, and the apparatus further comprises a polarisation modulator operable to launch the optical pulses into the fibre in such a way that the power of the optical pulses is firstly directed entirely into one of the principal states of polarisation of the fibre and then the other, thereby to interrogate the principal states of polarisation sequentially; and the signal processing means being operable to use the returned optical interference signals from both principal states of polarisation separately to determine the absolute optical path length for each propagation mode independent of the other mode [claim 43].

An apparatus where the parameter comprises temperature [claim 44].

An apparatus where the parameter comprises strain [claim 48].

An apparatus where the optical fibre is a high-birefringence fibre, the birefringence of which changes in response to strain applied to the optical fibre [claim 49].

An apparatus where the birefringence of the high birefringence fibre also changes in response to temperature, and the signal processing means is further operable to compensate the returned optical interference signal for effects arising from temperature at the said location [claim 50].

An apparatus where the parameter comprises pressure [claim 52].

An apparatus where the said optical fibre comprises a side-hole fibre [claim 53].

An apparatus where each sensor element of the fibre is located within a sealed elliptical tube filled with a pressure-transmitting fluid [claim 54].

An apparatus where the selected parameter depends on a localised event moving along the region of interest, and the signal processing means is operable to determine the value of the selected parameter over time at more than one said location, and to determine the movement of the localised event from the determined values of the selected parameter [claim 57].

An apparatus where the localised event is a user-induced event [claim 58].

An apparatus where the localised event is a volume of fluid within the region of interest that has a different temperature, pressure, or density from surrounding fluid in the region of interest, the selected parameter being temperature, pressure, or density, respectively [claim 59].

An apparatus further for measuring a second selected physical parameter at the location within the region of interest, where said optical path length between the said reflectors is further dependent upon the second selected parameter; and the signal processing means is further operable to determine the value of the second selected physical parameter from the determined absolute optical path length [claim 60].

An apparatus operable to use the measured value for the parameter to determine a value for a further measurand dependent upon said parameter, and where the said optical fibre is provided with a coating which responds to the said further measurand by stretching or shrinking [claim 64].

An apparatus where the said coating is electro-strictive [claim 66].

An apparatus where the said coating is magneto-strictive [claim 67].

An apparatus where the coating is designed to be sensitive to a selected chemical measurand [claim 68].

An apparatus where the source means are operable to launch light at a fixed wavelength and at a varying wavelength into the fibre, and the signal processing means are operable to use the interference signal from interrogation at the fixed wavelength to determine high frequency phase changes [claim 69].

An apparatus where the signal processing means are further operable to use the high frequency phase changes to correct for dynamic errors in the returned optical interference signals [claim 72].

An apparatus where the region of interest lies within an oil well [claim 74].

Nonetheless, these features are well known in the art and would have been obvious modifications of the method and apparatus disclosed in Kersey, as evidenced by Prohaska.

A method where the optical fibre comprises polarisation-maintaining fibre and light is launched into the fibre in such a way that the power of the light signal is firstly directed entirely into one of the principal states of polarisation and then the other, thereby to interrogate the principal states of polarisation sequentially, the returned interference signals from both principal states of polarisation being used separately in the said process for determining the absolute optical path length for each propagation mode independent of the other mode [claim 5] (col. 1, lines 48-52) where to measure polarization correctly polarization-maintaining is an

obvious requirement of a fiber, and where measuring the optical path length is a basic function of an interferometer.

A method in which the selected parameter comprises temperature [claim 6] (col. 3, lines 20-24) where being able to measuring multiple parameter types is an obvious benefit to any device.

A method in which the selected parameter comprises strain [claim 10] (col. 13, lines 16-19) where being able to measuring multiple parameter types is an obvious benefit to any device.

A method where the optical fibre is a high-birefringence fibre, the birefringence of which changes in response to strain applied to the optical fibre [claim 11] (col. 2, lines 12-15) where measuring strain with birefringence fiber is an obvious modification of the fiber optics system.

A method where the birefringence of the high-birefringence fibre also changes in response to temperature, and the method further comprises compensating the returned optical interference signal for effects arising from temperature at the said location [claim 12] (col. 3, lines 28-31) where compensating for temperature changes is a liquid is an obvious benefit when trying to acquire accurate results.

A method in which the selected parameter comprises pressure [claim 14] (col. 1, lines 53-57) where being able to measuring multiple parameter types is an obvious benefit to any device.

A method where the said optical fibre comprises a side-hole fibre [claim 15] (Abstract, lines 15-20) where measuring pressure accurately requires a hole in the side of the fiber to allow liquid to flow near the fiber.

A method where each sensor element of the fibre is located within a sealed elliptical tube filled with a pressure-transmitting fluid [claim 16] (col. 3, lines 2-4) where geometric shape can be varied to allow better sensitivity or strength.

A method where the selected parameter depends on a localised event moving along the region of interest, and the method comprises determining the value of the selected parameter over time at more than one said location, and determining the movement of the localised event from the determined values of the selected parameter [claim 19] (col. 4, lines 66-67; col. 5, lines 1-16) where taking direct measurements near the event in question and using that specific parameter to determine movement in the fiber would be the most efficient use of an interferometric system.

A method where the localised event is a user-induced event (i.e. where the user taking readings off the detectors is local), and the method further comprises inducing the localised event [claim 20] (col. 4, lines 66-67; col. 5, lines 1-16) where taking measurements near the event in question would be the most efficient use of an interferometric system.

A method as where the localised event is a volume of fluid within the region of interest that has a different temperature, pressure, or density (i.e. where density can be attained from pressure reading) from surrounding fluid in the region of interest, the selected parameter being temperature, pressure, or density, respectively [claim 21] (col. 5, lines 10-13) where allowing multiple parameters to be measured within fluid would be an obvious benefit to a sensor.

A method where the measured value for the parameter is used to determine the value for a further measurand dependent upon the said parameter and where the said optical fibre is provided with a coating which responds to the said further measurand by stretching or shrinking [claim 26] (col. 8, lines 3-9) where using a measured value to gain further information has obvious benefits to efficiency.

A method where the said coating is electro-strictive [claim 28] (col. 9, lines 60-64) where allowing a coating to be of different types gives the obvious ability of more versatility in measuring.

A method where the said coating is magneto-strictive [claim 29] (col. 9, lines 60-64) where allowing a coating to be of different types gives the obvious ability of more versatility in measuring.

A method where the said coating is sensitive to a selected chemical measurand [claim 30] (col. 6, lines 45-48) where allowing a coating to be of different types gives the obvious ability of more versatility in measuring.

A method where the region of interest lies within an oil well (i.e. where fluid in reference could be an oil well or any liquid) [claim 36] (col. 3, lines 2-4) where allowing the sensor to measure in a specific fluid gives more measuring versatility.

An apparatus where the said optical fibre comprises polarisation-maintaining fibre, and the apparatus further comprises a polarisation modulator operable to launch the optical pulses into the fibre in such a way that the power of the optical pulses is firstly directed entirely into one of the principal states of polarisation of the fibre and then the other, thereby to interrogate the principal states of

polarisation sequentially; and the signal processing means being operable to use the returned optical interference signals from both principal states of polarisation separately to determine the absolute optical path length for each propagation mode independent of the other mode [claim 43] (col. 1, lines 48-52) where to measure polarization correctly polarization-maintaining is an obvious requirement of a fiber, and where measuring the optical path length is a basic function of an interferometer.

An apparatus where the parameter comprises temperature [claim 44] col. 3, lines 20-24) where being able to measuring multiple parameter types is an obvious benefit to any device.

An apparatus where the parameter comprises strain [claim 48] col. 3, lines 20-24) where being able to measuring multiple parameter types is an obvious benefit to any device.

An apparatus where the optical fibre is a high-birefringence fibre, the birefringence of which changes in response to strain applied to the optical fibre [claim 49] (col. 2, lines 12-15) where measuring strain with birefringence fiber is an obvious modification of the fiber optics system.

An apparatus where the birefringence of the high birefringence fibre also changes in response to temperature, and the signal processing means is further operable to compensate the returned optical interference signal for effects arising from temperature at the said location [claim 50] (col. 3, lines 28-31) where compensating for temperature changes is a liquid is an obvious benefit when trying to acquire accurate results.

An apparatus where the parameter comprises pressure [claim 52] (col. 1, lines 53-57) where being able to measuring multiple parameter types is an obvious benefit to any device.

An apparatus where the said optical fibre comprises a side-hole fibre [claim 53] (Abstract, lines 15-20) where measuring pressure accurately requires a hole in the side of the fiber to allow liquid to flow near the fiber.

An apparatus where each sensor element of the fibre is located within a sealed elliptical tube filled with a pressure-transmitting fluid [claim 54] (col. 3, lines 2-4) where geometric shape can be varied to allow better sensitivity or strength.

An apparatus where the selected parameter depends on a localised event moving along the region of interest, and the signal processing means is operable to determine the value of the selected parameter over time at more than one said location, and to determine the movement of the localised event from the determined values of the selected parameter [claim 57] (col. 4, lines 66-67; col. 5, lines 1-16) where taking direct measurements near the event in question and using that specific parameter to determine movement in the fiber would be the most efficient use of an interferometric system.

An apparatus where the localised event is a user-induced event (i.e. where the user taking readings off the detectors is local) [claim 58] (col. 4, lines 66-67; col. 5, lines 1-16) where taking measurements near the event in question would be the most efficient use of an interferometric system.

An apparatus where the localised event is a volume of fluid within the region of interest that has a different temperature, pressure, or density (i.e. where density

can be attained from pressure reading) from surrounding fluid in the region of interest, the selected parameter being temperature, pressure, or density, respectively [claim 59] (col. 5, lines 10-13) where allowing multiple parameters to be measured within fluid would be an obvious benefit to a sensor.

An apparatus further for measuring a second selected physical parameter at the location within the region of interest, where said optical path length between the said reflectors is further dependent upon the second selected parameter; and the signal processing means is further operable to determine the value of the second selected physical parameter from the determined absolute optical path length [claim 60] (col. 5, lines 41-46; col. 9, lines 32-40; Fig. 1) where determining two separate parameters allows for a more flexible sensor.

An apparatus operable to use the measured value for the parameter to determine a value for a further measurand dependent upon said parameter, and where the said optical fibre is provided with a coating which responds to the said further measurand by stretching or shrinking [claim 64] (col. 8, lines 3-9) where using a measured value to gain further information has obvious benefits to efficiency.

An apparatus where the said coating is electro-strictive [claim 66] (col. 9, lines 60-64) where allowing a coating to be of different types gives the obvious ability of more versatility in measuring.

An apparatus where the said coating is magneto-strictive [claim 67] (col. 9, lines 60-64) where allowing a coating to be of different types gives the obvious ability of more versatility in measuring.

An apparatus where the coating is designed to be sensitive to a selected chemical measurand [claim 68] (col. 9, lines 60-64) where allowing a coating to be of different types gives the obvious ability of more versatility in measuring.

An apparatus where the source means are operable to launch light at a fixed wavelength (i.e. wavelengths launched are fixed and can also be varied) and at a varying wavelength into the fibre, and the signal processing means are operable to use the interference signal from interrogation at the fixed wavelength to determine high frequency phase changes [claim 69] (col. 5, lines 4-8) where allowing the source to provide multiple or fixed wavelengths allows more point to be analyzed along the fiber.

An apparatus where the signal processing means are further operable to use the high frequency (i.e. where freq in ref is variable so can be high or low) phase changes to correct for dynamic errors in the returned optical interference signals [claim 72] (col. 12, lines 40-46) where analyzing dynamically the changing wavelength is a beneficial process in any interferometric apparatus.

An apparatus where the region of interest lies within an oil well (i.e. where fluid in reference could be an oil well or any liquid) [claim 74] (col. 3, lines 2-4) where allowing the sensor to measure in a specific fluid gives more measuring versatility.

Given the teaching of Prohaska, a person having ordinary skill in the art at the time of the invention would have readily recognized the desirability and advantages of modifying Kersey by employing the well-known features of interferometric systems. It is widely known in the art that allowing an

interferometer to measure multiple different types of parameters such as pressure or temperature would give a machine much more versatility in the field. Thus making it a much more efficient device to produce and use for multiple measurements in a fluidic environment.

19. As to claims 4, 22, 42 although Kersey in view of Prohaska doesn't expressly teach an interferometric system where principal states of polarization can be interrogated simultaneously it would have been obvious because a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense (col. 3, lines 7-12; col. 8, lines 26-33) where one of ordinary skill in the art would know that having two different sensing parameters could be measured not only sequentially but also simultaneously to gain predictable separate results.

20. Claims 70 and 71 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kersey in combination with Prohaska further in view of Hodgson et al. (U.S. Patent No. 6,269,198 and Hodgson hereinafter).

Although the system discloses in Kersey combined with Prohaska shows substantial features of the claimed invention (discussed in paragraphs above), it fails to disclose:

An apparatus further comprising an auxiliary optical fibre for deployment through the region of interest, reflectors being arrayed along the fibre to form an auxiliary array of sensor elements, the source means being operable to launch the fixed wavelength signal into the auxiliary fibre [claim 70]

An apparatus where the auxiliary fibre has a coating designed to enhance acoustic sensitivity [claim 71].

Nonetheless, these features are well known in the art and would have been obvious modifications of the method and apparatus disclosed in Kersey in combination with Prohaska further evidenced by Hodgson.

An apparatus further comprising an auxiliary optical fibre for deployment through the region of interest, reflectors being arrayed along the fibre to form an auxiliary array of sensor elements, the source means being operable to launch the fixed wavelength signal into the auxiliary fibre [claim 70] (col. 5, lines 39-42) where allowing for a second measuring tool to further verify or examine a separate location in the liquid has obvious benefits for further detailed readings of the liquid in question.

An apparatus where the auxiliary fibre has a coating designed to enhance acoustic sensitivity [claim 71] (col. 2, lines 13-16) where allowing the fiber to be more sensitive to acoustic disturbances would allow more accurate measurements.

Given the teaching of Hodgson in combination with Kersey in view of Prohaska a person having ordinary skill in the art at the time of the invention would have readily recognized the desirability and advantages of modifying Kersey and Prohaska in view of Hodgson by employing the well known and conventional features of fiber optical systems. Allowing for an extra sensor in a system to further verify a separate part of a liquid being studied is an obvious addition to increase the detail of the measurements or further to examine a separate

position within a liquid, where also then coating that fiber system with acoustically sensitive material would increase accuracy of prior stated measurements.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MICHAEL LAPAGE whose telephone number is (571)270-3833. The examiner can normally be reached on Monday Through Friday 7:30AM-5:00PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Walter Benson can be reached on 571-272-2227. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/Michael LaPage/
Examiner, Art Unit 4158

/Walter Benson/
Supervisory Patent Examiner, Art Unit 4158